

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

22 JUL 2004


(PCT Article 36 and Rule 70)

Applicant's or agent's file reference H 2536 PCT	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEA/416)	
International application No. PCT/US 02/40971	International filing date (day/month/year) 19.12.2002	Priority date (day/month/year) 19.02.2002
International Patent Classification (IPC) or both national classification and IPC H01M10/50		
Applicant 3M INNOVATIVE PROPERTIES COMPANY et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 8 sheets, including this cover sheet.
- ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 20 sheets.

3. This report contains indications relating to the following items:
- I ☒ Basis of the opinion
 - II ☐ Priority
 - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
 - IV ☐ Lack of unity of invention
 - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
 - VI ☐ Certain documents cited
 - VII ☐ Certain defects in the international application
 - VIII ☐ Certain observations on the international application

Date of submission of the demand 05.09.2003	Date of completion of this report 18.06.2004
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**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. **PCT/US 02/40971**

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, Pages

2, 3, 5-11, 13, 15, 17, 20-22, as originally filed
24-26

1, 3a, 4, 12, 14, 16, 18, 19, 23 received on 29.03.2004 with letter of 26.03.2004

Claims, Numbers

1-66 received on 24.05.2004 with letter of 24.05.2004

Drawings, Sheets

1/9-9/9 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
☐ the language of publication of the international application (under Rule 48.3(b)).
☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
☐ filed together with the international application in computer readable form.
☐ furnished subsequently to this Authority in written form.
☐ furnished subsequently to this Authority in computer readable form.
☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

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5. ☒ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

see separate sheet

6. Additional observations, if necessary:

see separate sheet

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	1-66
	No: Claims	
Inventive step (IS)	Yes: Claims	1-66
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-66
	No: Claims	

2. Citations and explanations

see separate sheet

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/US02/40971

Re Item I

Basis of the report

The amendment "having a strength sufficient to hold a pressure" in claim 32 has no basis in the application as originally filed and does, hence, not meet the requirements of Article 34.2.b PCT. The following statement therefore does not take this amendment into consideration.

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Reference is made to the following documents:

- D1: DE 198 49 491 C (DAIMLER CHRYSLER AG) 5 January 2000 (2000-01-05)
- D2: PATENT ABSTRACTS OF JAPAN vol. 1995, no. 06, 31 July 1995 (1995-07-31) & JP 07 073908 A (NIPPONDENSO CO LTD), 17 March 1995 (1995-03-17)
- D3: WO 02 27816 A (OVONIC BATTERY CO) 4 April 2002 (2002-04-04)
- D4: DE 195 03 085 A (DEUTSCHE AUTOMOBILGESELLSCHAFT) 12 September 1996 (1996-09-12)
- D5: EP-A-1 033 772 (TOYOTA MOTOR CO LTD ;MATSUSHITA ELECTRIC IND CO LTD (JP)) 6 September 2000 (2000-09-06)

2.

2.1. Technical problem stated by the Applicant.

The subjective technical problem is to provide a thermal management system for rechargeable batteries with high energy output, such as batteries in electric vehicles, which maintains the storage cells at a nominal operating temperature and, therefore, provides for an optimal performance, reliability, safety and life-time of these batteries. Especially for advanced rechargeable batteries, such as batteries based on lithium ion, lithium polymer, lithium ion polymer cells, also changes in volume need to be considered when the cells are charged / discharged.

2.2. Solution proposed by the Applicant.

It is proposed (claim 1) to cool a plurality of electrochemical cells, such as a stack of electrochemical cells, by providing a cooling bladder formed of a conformable thermally conducting material and being in thermal contact with at least one of the two planar surfaces of each cell during volumetric volume changes. A heat transfer medium passes through the cooling bladder. In addition, the cooling bladder can be pressurized to maintain the electrochemical cells in a state of compression during charge and discharge cycling (claim 32). Claim 52 relates to a method of providing cooling within an electrochemical storage device.

3. Novelty (Article 33(2) PCT).

3.1. D1 discloses a battery 1 comprising a plurality of individual spaced apart electrochemical cells 2 and a heat exchanger 6 (col. 3, line 49, - col 5, line 22). The cells may be prismatic gas-tight Ni / Cd or Ni / metal hydride cells and have an operating temperature between 20 - 25°C. The heat exchanger 6, which preferably is made as a single unit, has plates 17 comprising channels 15 and 16 for circulation of a coolant (Figs. 1 - 4). The two broad sides of the cells 2 are in thermal contact with a plate 17 (Fig. 6). The heat exchanger further comprises an inlet and an outlet. Water or a gas may be used as coolant. The material of the heat exchanger is preferably metal or a solid plastics, such as a polycarbonate. The fluid passes through the channels in an anti-parallel manner.

Hence, D1 discloses all technical features of claims 1, 2, 3, 4, 12, 13, 14, 24, 25, 27, 28, 29, 31, 33, 39, 40, 47, 48, 49, 51, 55 and 62 - 65 with the exception that the cooling construction is a "bladder". The term "bladder" implies a hollow structure, which is, under normal conditions already, deformable and conformable. Therefore, D1 is not prejudicial for novelty of these claims.

3.2. D2 also discloses a battery comprising a plurality of spaced-apart prismatic electrochemical cells 1 and a heat exchanger 7, which includes heat exchanging bags 23. The cells of D2 are considered to have planar opposing surfaces, at least to the same extent as in the present application. The cells of the present application may change their volume and, hence, do also not always have fully planar surfaces. D2 addresses the problem of improving the heat-exchanging efficiency even if the outside dimensions and the shape of the battery is slightly changed. These bags 23 surround

the individual cells 1 and are in close thermal contact with them. All bags are in fluid communication with each other by passages 24 so that a coolant can flow from the inlet to the outlet of the heat exchanger. The bags are made of a deformable material, such as rubber or a woven fabric. The assembly of bags is considered as a unitary hollow structure. It is further stated that the internal pressure of the coolant provides for a close contact of the bags with the cells. The ribs 25 are considered as supports at a bend location of the heat exchanger 7. Also the storage device of D2 lays within the ambit of the independent claims 1, 32 and 52 of the present application. However, these claims are novel with respect to D2, because the assembly of bags will not have a flat shape in an uninstalled configuration.

3.3. D3 is a certain published document according to Rule 64.3 PCT. For details see item VI, *infra*.

3.4. In D4 a battery 20 is formed of a plurality of cells 6. These cells are cooled by inserting a pouch 3 (or 3' or 3'') between two parallel walls of two neighboured cells. The coolant can be a water / anti freeze agent mixture. In D4 the coolant passes the cells in an unidirectional manner. D4 is not prejudicial to novelty of the independent claims 1, 32 and 52 of the present application, because individual pouches are inserted between two cells, whereas in these claims one bladder is provided for cooling of a plurality of cells.

3.5. D5 provides a battery comprising individual cells. Cooling of the cells is achieved by flowing a coolant in a meandering manner, i.e. like serpentine-like, between the individual cells (abstract and Figs. 14 and 15). Independent claims 1, 32 and 52 of the present application are novel over D5, because in D5 no cooling bladder is provided. Instead the flow paths for the coolant are formed by providing ribs to the individual cell housings.

4. Inventive step (Article 33(3) PCT).

4.1. Only the cooling mechanisms disclosed in D2, D4 and D5 are considered to be suitable to perform an optimized cooling in stacks of electrochemical cells, which change their volume during operation. The cooling structure of D1 is rigid and can therefore not adapt itself to changes in volume.

D5 does not provide a cooling bladder but instead assembles the electrochemical cell stack in a way that a plurality of coolant channels is formed. However, a disadvantage is probably that many seals have to be provided, which does not only lead to an increased cost of manufacturing but also to a lower reliability.

Only D2 and D4 teach hollow conformable structures, which are inserted between two adjacent cells and which are assembled of a plurality of bags or pouches. These documents are seen as the closest prior art.

4.2. As the objective technical it is seen to provide a hollow conformable structure through which a coolant can pass and which can be inserted between electrochemical cells and which is characterized over the hollow structures of D2 and D4 by having a simpler construction and, hence, being easier to manufacture and more reliable.

4.3. This problem is solved by providing an unitary cooling bladder, which can assume a substantially flat shape when in an unassembled configuration, and can be therefore considered as a flat shaped hose with a rectangular cross-section. Such a construction is neither hinted by any of D1, D3, D4 or D5 nor derivable by combination of two or more of these documents. Therefore, the subject-matter of the independent claims 1, 32 and 52 appears inventive.

5. Industrial applicability (Article 33(4) PCT).

Claims 1 - 66 fulfill the requirement of industrial applicability, since subject-matter of present application can be made or used (in a technological sense) in industry (Article 33(4) PCT).

Re Item VI

Certain documents cited

D3 (= WO 02/27816) is a certain published document according to Rule 64.3 PCT. D3, which has the International application number PCT/US01/30070, is published on April 4, 2002, has a filing date of September 25, 2001, and claims priority of US 09/670,155 (September 26, 2000).

Re Item VIII

Certain observations on the international application

Clarity.

1. Claim 32 relates to the same apparatus as claim 1, because it does not contain further additional technical apparatus features (see also item I, supra). Hence, these claims differ from each other only with regard to the definition of the subject-matter for which protection is sought and in respect of the terminology used. The aforementioned claims therefore lack conciseness.
2. The configuration depicted in Fig. 10 of the present application lays out of the invention, because it cannot have a substantially flat shape in an unassembled configuration.
3. The term "about" used in parts of the description and in some of the claims for the specification of numerical values is vague and leaves the reader in doubt about which values are exactly intended to be claimed.